Technique and Clinical Results of Carotid Stenting under Distal Protection

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Summary

We perfomed carotid artery stenting(CAS) in 215 patients from August 1997 to October 2003 mainly using the distal protection technique. Our technique and clinical results are described in this paper.

Material and Methods

CAS was performed without protection in initial 14 cases. Protection was done only at the time of post-dilatation in next 39 cases using naviballoon system [8]. In the next 81 cases, CAS was performed under protection at the time of pre and post-dilataion using naviballoon system [8]. PercuSurge guardwire system was used for next 79 cases during CAS. Four cases, which had a risk of lesion crossing, were done under Parodi's anti-embolic system.

The characteristics of our method were that the lesion was fully dilated at the period of predilatation under protection and a stent was deployed. If sufficient gain was not obtained after stent deployment, post-dilatation was added under distal protection. This method was done for 160 cases.

Results

Thrombo-embolic complications appeared in three of 14 cases, in which CAS was done without any protection. One was major stroke and two were minor stroke. One embolic complication appeared in 39 cases treated under protection at the period of post-dilation. The embolic complication appeared at the period of pre-dilation without protection. One thrombo-embolic complication, one hyperperfusion syndrome, and one non-stroke death appeared in 81 cases treated under protection at pre and post-dilataion. One thrombo-embolic complication due to acute stent occlusion appeared in 79 cases treated under total protection using PercuSurge. However, we failed lesion crossing using PercuSurge in two cases with very tight stenosis. A naviballoon successfully crossed the lesion. The rate of ischemic complication was 21% in the group without protection, while it was 1.5% in group with various types of protection. The overall morbid/mortality rate in our series was 2.5%.

Representative Case

A 56-year-old male was admitted to our hospital due to sudden onset of aphasia and moderate left hemiparesis. A low density area already appeared in the anterior part of the left middle cerebral artery. Angiogram on admission demonstrated the nearly total occlusion of the left internal carotid artery (figure 1A). The left anterior and middle cerebral artery was

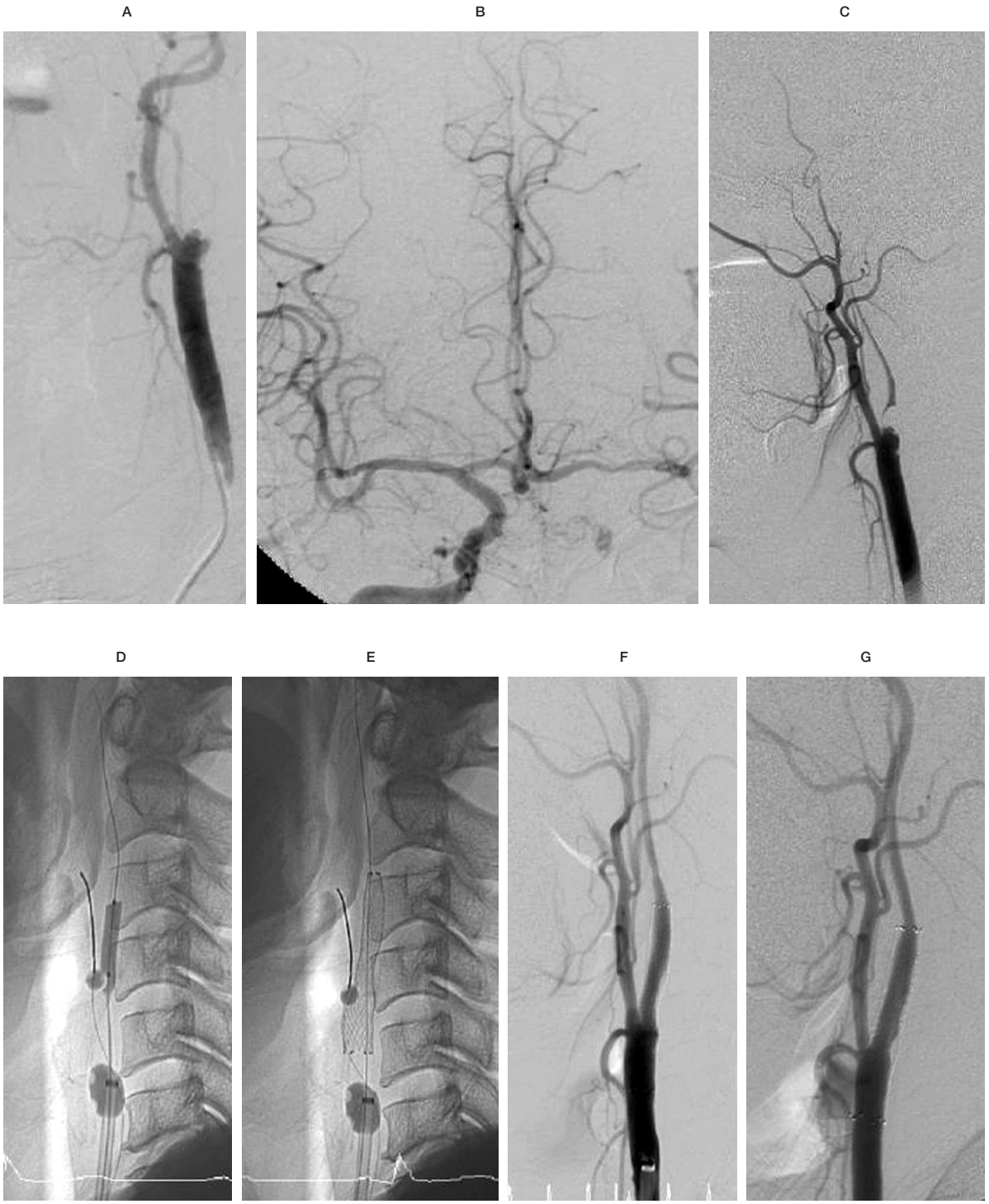

Figure 1 Angiographic findings: A) Left common carotid angiogram (oblique view). The left internal carotid artery was faintly opacified but the distal portion was not identified in arterial phase. B) Right internal carotid angiogram (anteroposterior view). The left anterior and middle cerebral artery were opacified via the anterior communicating artery. C) Left common carotid angiogram two weeks after onset. The left internal carotid artery was opacified like a string in arterial phase. D) Lateral view of PTA using Parodi's system. The common carotid artery and the orifice of the external carotid artery was occluded with a balloon and the stenotic portion was dilated with a PTA balloon. E) Lateral view of stent deployment using Parodi's system. The SMART stent was deployed under common and external carotid occlusion. F) A left common carotid angiogram after stenting. The stenotic portion was well dilatated after stenting. G) A left common carotid angiogram 6 months after stenting. The stenotic portion was wide open.

opacified via the right anterior communicating artery (figure 1B). He was treated conservatively for two weeks. His neurological condition got better and hemiparesis and aphasia remarkably improved. Follow-up angiogiogram revealed the pseudoocclusion of the left cervical internal carotid artery (figure1C). Intracranial portion of the ICA was opacified at the late capillary phase. PTA/stenting was planned to prevent from the recurrent embolic stroke from the left ICA and to keep the patency of the left cervical ICA for the treatment of the contralateral ICA stenosis in the future. Parodi's antiembolic system was used to prevent embolic complication during lesion crossing as well as PTA/stenting, because PercuSurge seemed difficult to cross the tight stenosis. The external carotid artery was occluded with a balloon catheter at its orifice.

The common carotid artery was obliterated by inflation of the balloon of the 10.5 F catheter and the distal end of the catheter was connected to the 4 F sheath introduced in th femoral vein via a filter (figure 1D,E). A 0.014" microguidewire (Choice PT, Boston Scientific, U.S.A.) was introduced through the stenosis and a 4 x 20 mm PTA balloon catheter (Savvy, Johnson & Johnson, U.S.A) was navigated to the lesion. The balloon was inflated for 60 seconds under 6 atm. Then, a 8 x 40 mm self-expanding stent (SMART, Johnson & Johnson) was deployed to cover the entire lesion. Satisfactory dilataion was obtained without any neurological complication and any new ischemic lesion on MRI (figure 1F). Any further neurological deficit and restenosis did not appear during the six months follow-up period (figure 1G).

Discussion

Embolic protection is one of the most important problems to improve the overall results of carotid stenting1-10). Various types of protection devices have been developed including distal balloon protection system, filter wires, and proximal flow control technique (Parodi's system) [1,5,6,8,10].

The results of carotid stenting improved after introduction of protection system as shown in our series (ischemic complication reduced from 21% to 1.5%) as well as recent reports. However, there still exists the discussion which protection system is better. Filterwires seem suitable for cases in which ischemic symptoms appear during carotid occlusion, but they are not used for curved lesions or tight stenosis. Parodi's antiembolic sytem is appropriate for cases with floating embolus in which embolic complication may appear during lesion crossing. The disadvantage of PercuSurge system is the softness of the tip of the wire. This system is difficult to treat the tight stenosis or curved lesion. For tight stenosis or curved lesion navibalioon system or Parodi's system is more suitable than PercuSurge. Lesion with floating thrombus, Parodi's system seems best to prevent embolic complication during lesion crossing.

Conclusions

The results of CAS will improve the use of appropriate protection systems for each lesion.

References

1 Albuquerque FC, Teitelbaum GP et Al: Balloon-protected carotid angioplasty. Neurosurgery 46: 918-923, 2000.
2 Eckert B, Thie A et Al: H: Transcranial Doppler sonographic monitoring during percutaneous transluminal angiopalsty of the internal carotid artery. Neuroradiology 39: 229-234, 1997.
3 Golledge J, Mitchell A et Al: Systemic comparison of the early outcome of angiopalsty and endarterectomy for symptomatic carotid artery disease. Stroke 31: 1439-1443, 2000.
4 Henry M, Amor M et Al: Angioplasty and stenting of the extracranial carotid arteries. J Endovasc Surg 5: 293-304, 1998.
5 Kastrup A, Groschel K et Al: Early outcome of carotid angioplasty and stenting with and without cerebral protection devices: a systemic review of the literature. Stroke 34: 813-819, 2003.
6 Shawl F, Kadro W et Al: Safety and efficacy of elective carotid artery stenting in high-risk patients. J Am Coll Cardiol 35: 1721-1728, 2000.
7 Teitelbaum GP, Lefkowitz MA et Al: Carotid angiopalsty and stenting in high-risk patients. Surg Neurol 50: 300-312, 1998.
8 Terada T, Tsuura M et Al: Results of endovascular treatment of internal carotid stenoses using a newly developed balloon protection catheter. Neurosurgery 53: 617-625, 2003.
9 Vitek JJ, Roubin GS et Al: Carotid artery stenting: technical considerations. Am J Neuroradiol 21: 1736-1743, 2000.
10 Whitlow PL, Lylyk P et Al: Carotid artery stenting protected with an emboli containment system. Stroke 33: 1308-1314, 2002.

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